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Structure and Repetition

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STRUCTURE AND REPETITION

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Fine Arts at Virginia Commonwealth University.

by

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Major Director: William Hammersley
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This work is the result of an exploration into the relationship of form and pattern. Its inspiration began as an experiment where certain two dimensional graphical patterns were interpreted as three dimensional elements in a lattice-like assembly. The resulting compositions are built entirely of MDF, and each piece is made from multiple copies of one or two identically shaped parts that are joined with shallow grooves. Some of the pieces resemble Asian architectural lattices as well as the scientific models of molecules in crystals. Often, the flat components seem to undulate in space or twist into impossible shapes. Although the various compositions appear dissimilar, the differences are a result of only minor changes to the individual parts that comprise them. Therefore, the work is metaphorically analogous to other complex systems made from simple components such as the structure of matter, the organization of cells, or primordial life in general.

Introduction

It is with difficulty that I begin this thesis on the work prepared for my upcoming VCU MFA exhibition. The work is recent -- made between early February and early April, 2009. In addition to having little time to reflect on it, the work is also positioned at the intersection of a variety of academic and personal concerns. Among these are: an investigation of certain patterns that have been used to create lattice-like structural forms; an inquiry into creative process as it relates to the new technologies of virtual design and CNC routing; as well as an investigation of the use of planar materials in three dimensional compositions. Overlaid upon the whole of the work has been my own experience in the studio furniture movement and the associated difficulties of making original work which is both exciting and economically viable. These interests and concerns are knitted together with my lifelong interest in science, geometry, and mathematics as well as my belief in a kind of unity of experience. In this thesis I will attempt to tease apart these things and present a rational analysis for my work.

The Nature of the Work

As can be seen in the exhibition, this body of work has some obvious characteristics. All the compositions are made from MDF using a kind of lattice structure. However, unlike a standard lattice where long thin strips of wood are joined at the points of crossing, this lattice is built of small pieces joined together with dado joints. Although numerous parts make up the whole of each work, usually only one or two differently shaped parts are used to create each structure. The subsequent patterns and forms are a testament to the variety that can be produced by making small changes to a simple part.

It is needless to say that these works use repetition as a design element. In reality, the work is the incarnation of repetition. In addition, bends and angles have been added in many compositions to enable the lattices to fold back upon themselves creating cylinders, closed forms, or even structures that resemble functional items. In many instances the parts, despite being made of a flat material, appear to bend and twist. The resulting compositions become difficult to comprehend.

The work also exhibits a curious dichotomy of scale. At times it may appear like a model of a much-larger architectural work. It is easy to imagine standing below the forms while looking upward. At the same time, the work resembles the structure of microscopic organisms or borrows form from the molecular world of crystalline lattice. This simultaneous association with both the micro and the macroscopic, which embodies the knowledge that everything in the universe shares common physical properties, gives many of the compositions a resonance with a kind of greater harmony.

In addition, cylindrical pieces in the group loosely resemble the structure of DNA while at the same time undulating like some multifaceted cam shaft. Curving forms work against the squareness of the joinery to allow the pieces to be both mechanical and organic. Here again the work seems to simultaneously exist in opposite extremes and speaks to the idea that the organic and the mechanical are polar expressions of some unifying principle.

The compositions are also exercises in geometry and applied topology. The various lengths and angles used to create many of the forms involved mathematical calculations. That organic shapes embody purely geometrical ones is easily observed in starfish or the alternating arrangement of leaves on certain plants. Therefore, the works reinforce the conclusion that geometry is one with nature, and that mathematics does describe aspects of the real world.

Large and small, mechanical and organic, simple yet complex, natural and mathematical, because the work draws upon so many opposing associations it vibrates with an energy that flows naturally from “all things big and small.” The work is a reminder that creation, in all its diversity, is built of small simple things that are repeated and repeated and repeated.

Material and Process

To be involved with craft is to be involved with materials and the processes used to manipulate them. Therefore, the choice of both material and process carry significance. In woodworking, if a maker limits himself to solid wood and chooses to use only hand tools, he has already made a statement about his work that will be present despite its form or style. The work, then, must accommodate that statement about materials and process in its final presentation. In that same vein, my choice of sheet materials (in this case half inch MDF) and use of CNC routing are also symbolic and significant.

When we look down the hallway in the Craft and Material Studies department, we see in the various areas remnants of significant developmental achievements in the history of mankind. Most people have heard of “the bronze age” or “the iron age.” The making and working of metal was once the cutting edge of technology. In addition, pottery is used to date archeological sites, as stages of its development are significant milestones in the history of a culture. In addition, the cultivation of vegetable fiber is also significant. However, I have never heard anyone talk about “the wood age.” This is because wood has always been one of mankind’s most ubiquitous materials, and is as germane to human existence as mud. Therefore, to choose solid wood as a compositional material is to be associated with a tradition that is as long and deep as human history. But what does it mean to choose plywood, particle board, or MDF as one's compositional material?

Manufactured boards are planar materials. To make them, wood fibers are removed from their natural orientation in solid wood, rearranged into a panelized form, then bonded in place with heat, pressure, and adhesive. The resulting sheets are rectilinear, flat, easily stored and transported, and are less susceptible to seasonal expansion and contraction. In addition, the panels are close to the maximum size and weight that an average person can carry. Because panels are generally four feet by eight feet, much of modern residential architecture is also designed in modules of this size. Consequently, to choose plywood, particle board, MDF, or some other manufactured board for one's work, is to associate that work with flatness, utility, and the particular control that man exerts in the world.

In addition to a material choice that brings the work into an association with the built environment, the process which I have chosen to create the work is also loaded with technological associations. Just as metalwork was once mankind's latest technology, now computers are changing our lives. However, computers are the culmination of a mind-boggling array of intellectual achievements. That I can sit at this keyboard and watch these words as I type them is as close to a miracle as I am likely to witness. For beneath these keys lies an array of metal paths that connect various areas of silicon wafers to one another. Upon those wafers is etched a similar grid of connections so tiny that they can barely be seen with a microscope. It seems impossible that as the proper voltage is supplied, electrons will flow through these circuits and thereby conform themselves to the vague representations of numbers as binary digits, and that those numbers are understood as operational instructions to be executed millions of times per second. Therefore, to be using a computer in the design and execution of one's work is to stand upon an incredible pinnacle of human intellectual progress.

While the use of a computer as a design aid has long been commonplace, new technologies are being developed which allow virtual works to become manifest as a real objects. Plotters and printers were among the first computer output devices, and new low-cost CNC routers are yet another and have the advantage of cutting and shaping a variety of materials. Because the CNC router owned by the Sculpture Department is a three axis machine, it is ideally suited to working planar engineered materials like plywood, particle board, and MDF. Thus, by making my work on the computer and then manifesting it into reality with the CNC router, the work in this exhibition is fundamentally an expression of the materials and process used to create it.

Although it might appear that using technology is the antithesis of a traditional approach to craft process, much of that process remains intact. One aspect of craft is that the working hands often inform the mind of what needs to be done. Small accidents are used as creative "jumping-off points" and serve to inspire forms and ideas that no one "thought of." However, the same has happened to me in the course of this work. What started as an investigation of pattern that exists only in my computer has morphed into a new way of forming three dimensional structures.

Ironically, despite the computer's miraculous powers, it is also merely another tool at the disposal of a maker. Because the CNC router does much of the work that was once done by hand, the hand of the craftsman is not as present in the physical world. However, the craftsman's virtual hand is still responding to accident and opportunity, informing the mind of new possibilities. Therefore, as we ponder what it means to be using technology to create this body of work, we find the association of mankind's incredible intellectual achievements as well as a persistent and traditional creative process.

In conclusion, the influence of material and process is vital to any crafted object. Because I have used planar materials, software design tools, and the CNC router to create the work, the pieces embody a scientific and mathematical overtone. Despite this the work has a surprising organic quality. What material and process have supported in the work is the realization that engineering is approaching the complexity of biology, and that biology is becoming an aspect of engineering.

Influences

The work prepared for this thesis exhibition is an exploration of form as it is expressed through certain repetitious structures. The work has little in the way of formal influences, as it was conceived as an independent investigation. While making the work, I looked for signs that others have already examined this area, and have found some comparable ideas. Because it is unlikely that I am the first to think of this, I continue to search for an equivalent investigation in both artistic and mathematical literature. However, I have yet to find anyone who has approached the creation of three dimensional structures in quite this way. Consequently, although a few sources of influence can be recognized in my personal interests, my history, and the narrative of my past academic studies, these remain only minor influences. I elucidate them here, but also explain additional ones in the History section of the thesis, which has been expanded to include my time at VCU as well as time before. Although this work is nearly devoid of formal influences, there are some thematic elements that take their direction from my personal interests. These are: my affinity for things technical and scientific, my enjoyment of simple mathematical calculations, and my love of building things.

It goes without saying that the work is influenced by my interest in the phenomenon of nature. Although I spent time as an engineering and physics major in college, my interest in phenomena is lifelong. One important experience happened in Illinois when I was around six. My family lived in the last house of a new development which backed up to farmland. In the spring the field beside the house became flooded, and remained so for over a week. What had been a marshy area of field was then a sizable lake and yet was a mere foot deep. One day my father decided to take my sister and me for a hike across the water. We saw birds and cattails, collected water samples, and got muddy up to our knees. When we got home, my father took out his microscope, and we looked at what was living in that water. To my surprise, it was teeming with a huge variety of miniature organisms. Since that time, I have always been interested in natural things.

Being the son of a physicist, my family's home was always full of books and interesting magazines. Popular Mechanics, Science, National Geographic, Scientific American, Fine Homebuilding, and Fine Woodworking were among the magazines that came over the years. Building things and learning about how things worked was what my family did for fun. Consequently, as a youngster I built models of ships, airplanes, and spacecraft, and I also started making things from scratch. After taking algebra in the ninth grade, and having learned about parabolas, I built a parabolic dish to use for listening to distant sounds. I used y=x2 to plot the curve of cardboard ribs to which I glued additional wedge-shaped pieces. Although not as successful as I had hoped, the experience shows that at 14 years of age I was already willing to employ mathematical theory in the making of an object. This tendency has carried through much of my professional life and continues here.

An additional general influence on my work is the artist Leonardo da Vinci, someone whose work also crosses the border between art and science. As a youngster I was impressed with his sketchbooks and their thorough approach to recording ideas and working out possible solutions. Because of his example, I have kept sketchbooks for most of my life, and these have allowed me to review my thinking at a later time. Often, an idea or solution that eluded me is found years after the fact. Sketchbooks have also helped me to visualize things that were too difficult to imagine. Interestingly, the current work went even beyond the ability of a sketchbook to assist me. This exhibition is actually the presentation of prototypes built as visual aids because sketching proved inadequate.

Another area that has been an important influence has been years of writing computer programs. Before writing a program, one must first develop an algorithm which is a sequence of steps that must be done in a particular order to achieve a desired result. Most people use an algorithm when they follow a recipe in a cookbook. However, a computer algorithm involves a set of instructions that are logical and are often expressed as a series of equations or other numeric operations. Because there is no room for quantitative error in computer programming, learning to write algorithms for programming takes discipline. Often, after inputting a program, it can provide erroneous results. Mistakes need to be tracked down and corrected. This formal training in algorithm development has been useful to my thinking in general, as well as to this body of work.

The most important direct influence on this exhibition was the writing of Lewis F. Day. Several years ago, while living in Massachusetts, I became interested in historic ornament and began collecting and reading period texts on pattern and design. The books that had the greatest impact were: The Grammar of Ornament written by Owen Jones and published in 1856, and Pattern Design [1] by Lewis F. Day, originally published by B. T. Batsford in 1903. These two books helped add fuel to my interest in wallpaper and decorative borders. Last fall, while rereading Day's book, I began designing wallpaper samples in AutoCAD. By using the computer, I could follow along with the book, making exercises for myself. When analyzing Day's description for creating "Arab Diaper" I realized that his method could be generalized to create a whole variety of interlocking patterns. Although the method is not unique, this process is recognizable as an algorithm, and it has led me to create over 100 different wallpaper samples.

It was exciting to discover a method for creating patterns. Because I felt I needed to know more, I decided to examine techniques used by others. Since I have been a fan of M. C. Escher for many years, I focused on him. In addition, he was able to create a variety of patterns that I could not. Although there was a lot to learn, Escher ended up contributing little to the generation of the work. Eventually, I decided that continued study of Escher was unproductive. However, in retrospect, Escher's work may have had an unforeseen influence.

Escher's ideas are comparable to a field of mathematical study called "tessellation theory." This field developed out of the examination of crystal structures. Escher studied the work of mathematicians, but was ultimately unable to understand it. However, his work is undeniably related to tessellation. Escher himself talks about this in the introduction of M. C. Escher: The Graphic Work, and I quote him here:

> *"...all the numbered reproductions in this book were made with a view to communicating a specific line of thought. The ideas that are basic to them often bear witness to my amazement and wonder at the laws of nature which operate in the world around us. He who wonders discovers that this is in itself a wonder. By keenly confronting the enigmas that surround us, and by considering and analyzing the observations that I had made, I ended up in the domain of mathematics. Although I am absolutely innocent of training or knowledge in the exact sciences, I often seem to have more in common with mathematicians than with my fellow artists."*[2]

Escher is an artist whose work drifted into the realm of science and mathematics. My work appears to have done the same. However, what began for me as a naive exploration into counterchange pattern, and by extension into tessellation theory, then migrated into the realm of three dimensional structures.

I believe that it is impossible to disassociate an artist from his work. Somehow, the personality of the maker always seems to be expressed. It is no different here as this work, which appears structural, geometric, biologic, and full of repeated elements, seems like an instant snapshot of my personal interests and my history. On a deeper level, the process of creating the work reflects many of the other types of investigation with which I have been involved. These include a host of problem-solving disciplines like design, computer programming, and engineering, as well as art. The influences that can be discovered in the work are the same influences that are thematically present in my life.

Notes:

[1] Day, Lewis F., Pattern Design, Republished 1999 by Dover Publications, Mineola, New York, revised and enlarged in 1933 by Amor Fenn, p. 46-48

[2] Escher, M. C., M. C. Escher: The Graphic Work, translated by John E. Brigham. Published by Taco Verlagsgesellschaft und Agentur mbH, Berlin1989, p.6

Technical

Although the work for this exhibition appears complex, referencing scientific and mathematical themes, the work is not technically innovative because the processes used to create it are well established. My only innovation has been to use AutoCAD drafting and CNC routing in the studio setting, and I am not the first to do so. In addition, the lattice patterns I use are made from dadoed MDF, a common material joined in a traditional way. What AutoCAD has contributed to the work is to accurately model the shapes needed for lattice components. The created forms would have been impractical to make were it not for the CNC which can rout duplicate shapes with expediency.

All of the works for the show are made using the same method. The lattice components are first drafted in AutoCAD, then copied and arranged on a sheet of virtual material that corresponds to the size of the actual material that will be used. The data from AutoCAD is then exported as a ".dxf " file (drawing exchange format), and imported into "Part Wizard," software provided by the CNC manufacturer that converts vector drawings into the machine code needed to run the CNC router. After the router cuts the prepared project, the individual parts are then taken to the table saw where joinery dados are cut. Specially designed jigs hold the various parts at the correct angle on the crosscut dado sled.

Figure 1 is an illustration of a typical part layout on half inch MDF. Notice the two types of parts used in the project as well as the three dado jigs.

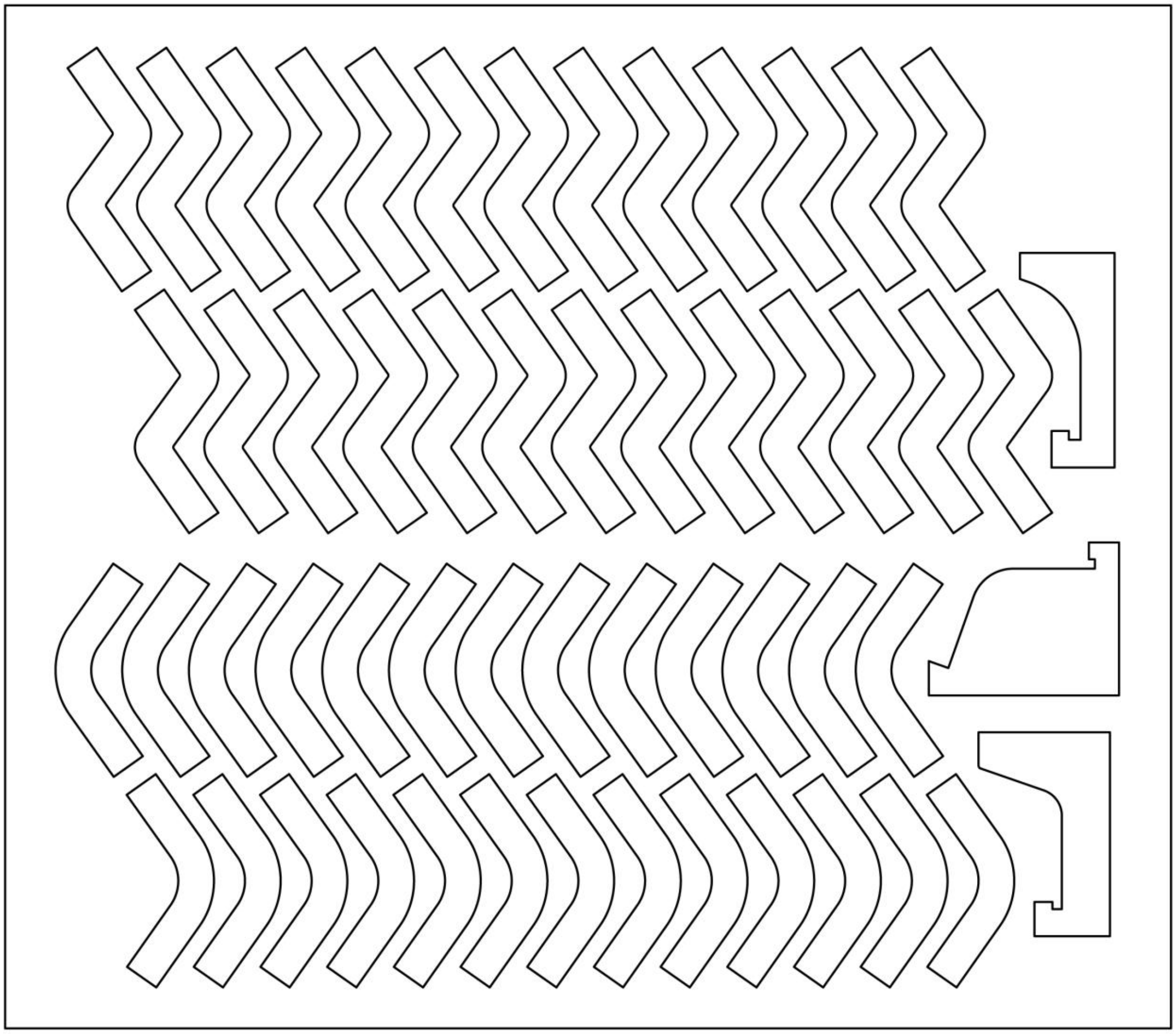

Figure 1: Typical arrangement of parts and jigs on a sheet of half inch MDF.

As stated previously, the inspiration for this work came from my interest in pattern that interlocks perfectly with itself. This type of pattern, called counterchange pattern, is well known. Although I developed my own method for creating counterchange patterns using AutoCAD, it is similar to the methods used by others and therefore is not worth a lengthy recounting. I will, however, show two examples of counterchange pattern created using AutoCAD, then compare them to my structural lattice patterns to illustrate the source of my ideas. In addition, I will briefly describe the various types of lattice pattern used in the exhibition and show examples of the bending and stretching of parts.

During the fall 2008 semester I developed a method for creating counterchange patterns in AutoCAD. Although not the only way to conceive or construct counterchange pattern, it has the advantage of relative expedience. Using this, I was able to create two related types of pattern. Not knowing an official name for them, I call them the following: The first is a “rotationally symmetric mirrored counterchange pattern,” and the second is a “rotationally symmetric stepped translational pattern.” Shortened names for these are “mirrored counterchange” and “linear counterchange” patterns respectively.

Figure **2** is a graphic sample of a mirrored counterchange pattern created in AutoCAD. Note that the dark figures, if turned ninety degrees, would fit exactly over the white areas. I refer to this type of pattern as “mirrored” because the enclosed figures are symmetrical around lines that bisect them.

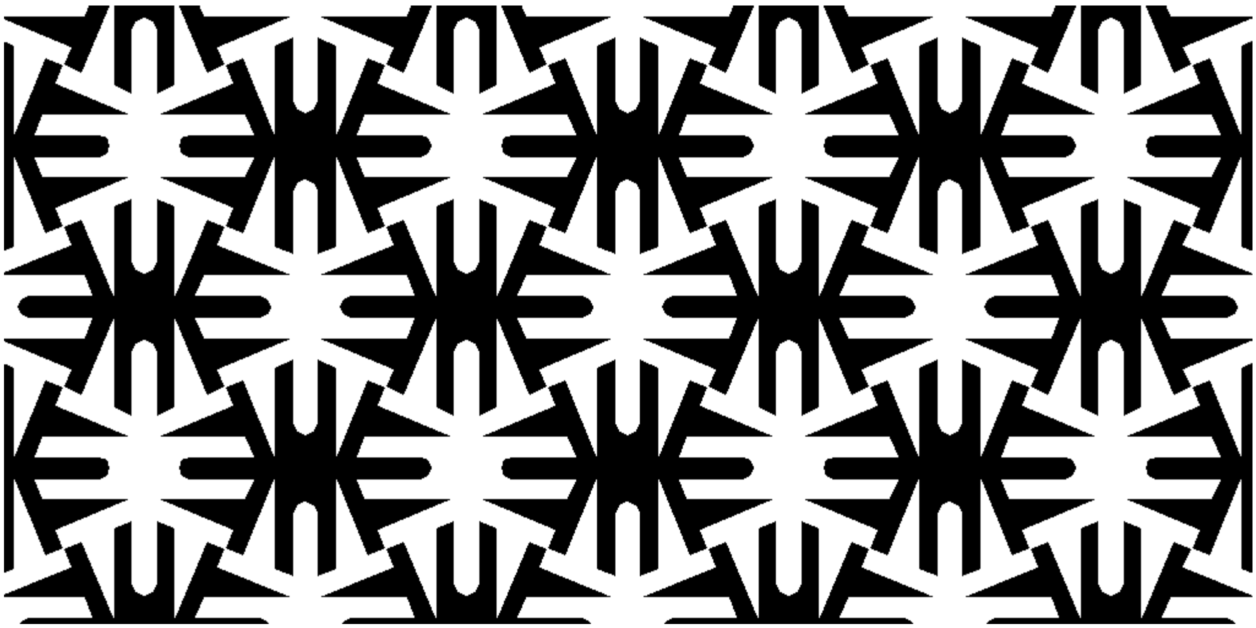

Figure 2: Mirrored counterchange pattern.

The illustration in

Figure **3** uses the same basic unit as the mirrored counterchange version. However, rather than treat the pattern in an equivalently symmetrical way, the pattern's base unit is translated to form the figures. This pattern is aptly described as a checkerboard pattern, and its rotational symmetry is clearly apparent.

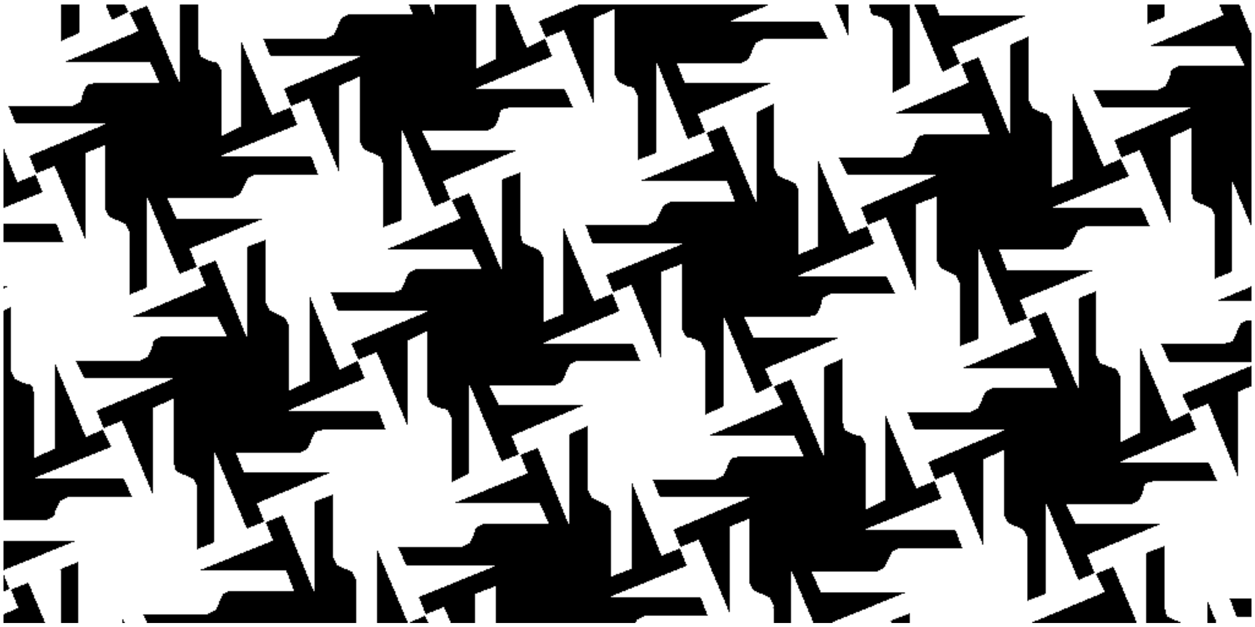

Figure 3: Linear counterchange pattern.

Although these graphical patterns were merely an intermediate step to creating lattice based compositions, the time spent learning about counterchange pattern has possible future use creating interlocking outlines for products. For example, I have developed an interlocking pattern for the body of a handheld mirror, which, when transformed into instructions for the CNC, can utilize nearly 100% of the routed material. Future products designed using counterchange pattern could include mirrors, clocks, and picture frames.

Although counterchange pattern can be created in an infinite number of graphical variations, there are only a few counterchange patterns that work as structures. The most useful are those which are analogous to the mirrored counterchange pattern, and I refer to the lattice based on a mirrored counterchange format as a “mirrored counterchange lattice.” The version of mirrored counterchange lattice based on the square is pictured in Figure **4** and is also used in the piece entitled “Column.” The pattern is strikingly similar to traditional basket-weave and has the advantage of not “running” downward as the lattice is assembled.

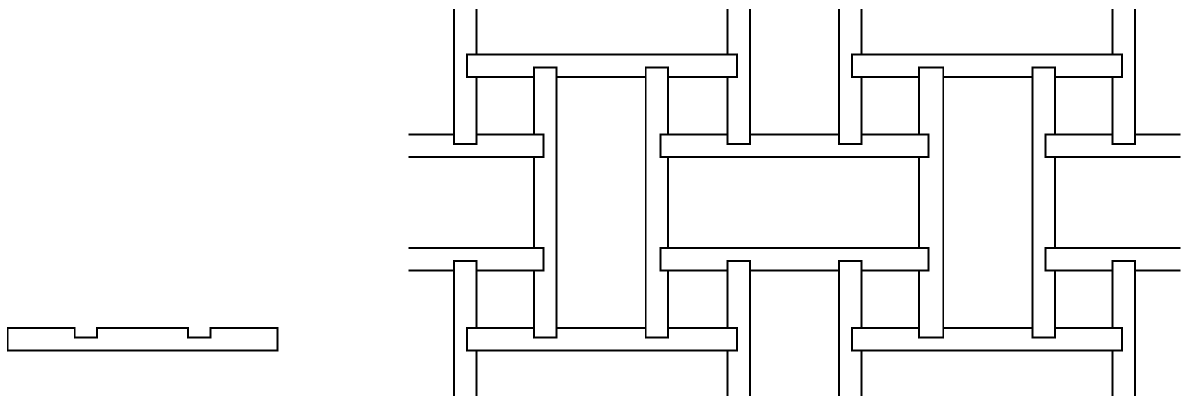

Figure 4: Square mirrored counterchange lattice and its component part.

The next pattern, illustrated in Figure **5**, is similar to mirrored counterchange lattice but is instead treated linearly. Like a graphical manifestation, the structural pattern produces a substantially different component part. Although the part has the same dimensions as the mirrored counterchange version, it has dados on both sides of the material. This type of pattern is exhibited in the piece “Spiral Cylinder,” where the downward run of the pattern is used to describe the spiral nature of a cylindrical form.

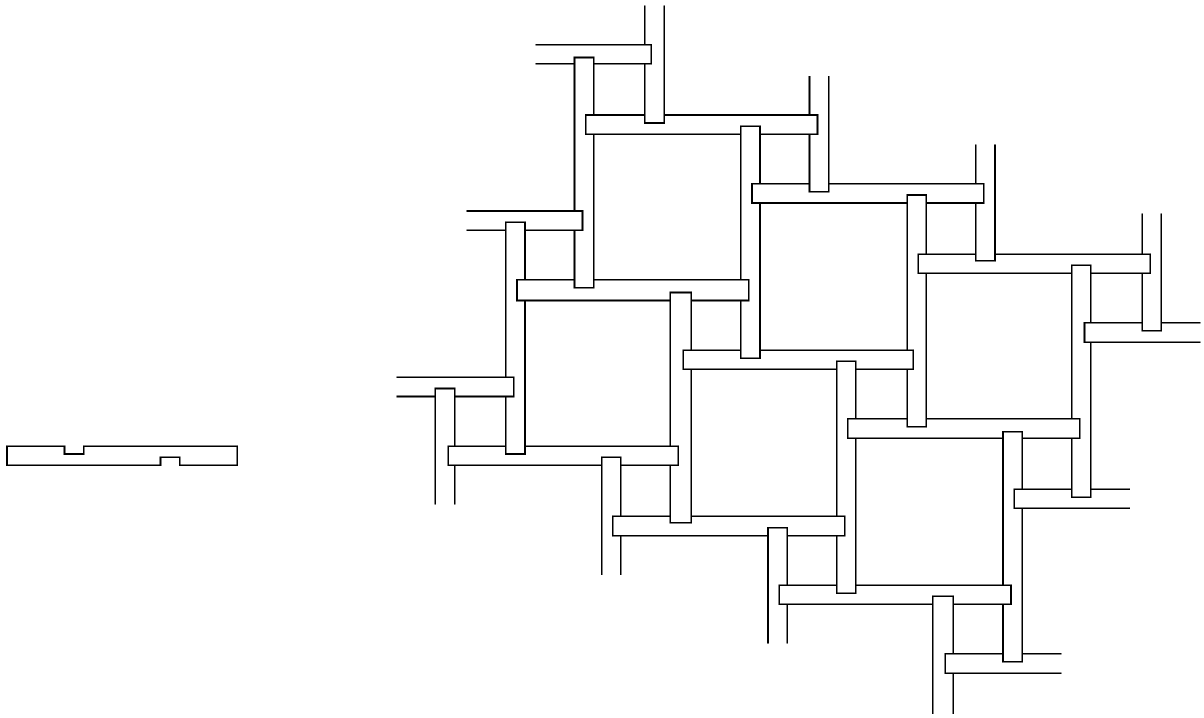

Figure 5: Linear counterchange lattice and its component part.

In addition to the two structural patterns shown above, I have included an example of triangular mirrored counterchange lattice. Shown in

Figure **6**, this pattern has been used both alone and in conjunction with the square version to create closed forms of structural lattice. Notice the angled dados in the unit part. By altering these angles and bending the parts, closed forms of different shapes can be created.

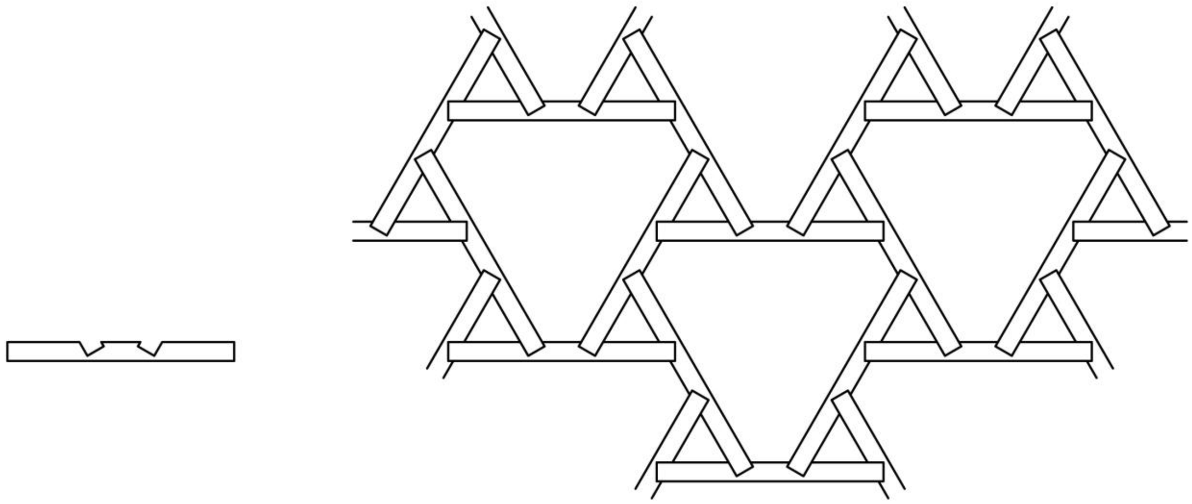

Figure 6: Triangular mirrored counterchange lattice and its component part.

One additional pattern shown in

Figure 7 is an interesting example of symmetry in lattice designs. The previous pattern parts, especially those for mirrored counterchange structures, contain a noticeable symmetry. However, for the pattern below, the unit part is asymmetrical. This pattern shows that the property of symmetry involves a relationship of placement and does not need to appear in the individual lattice component.

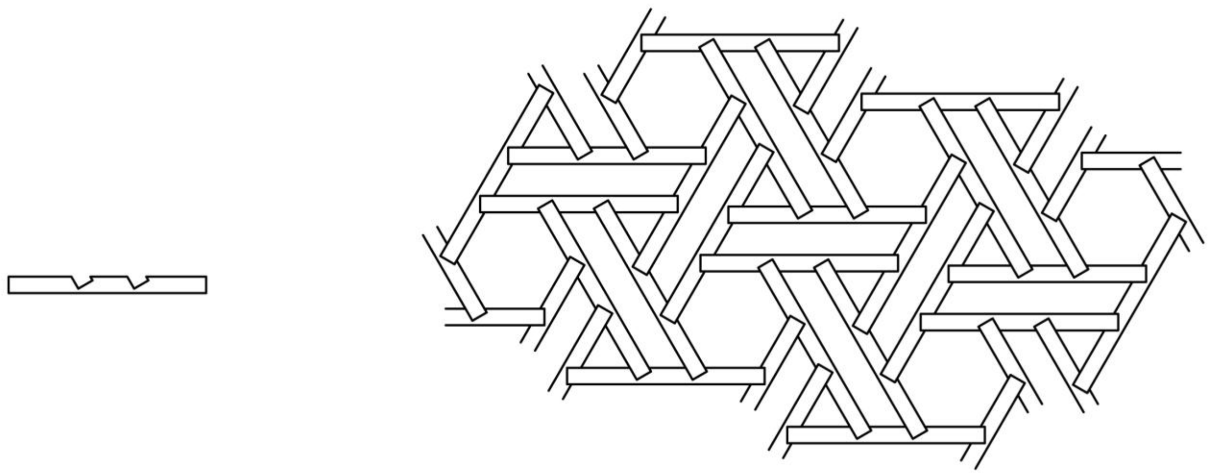

Figure 7: Hexagonal lattice produced from an asymmetrical part.

Another interesting aspect of working with counterchange lattice is the ability to stretch and distort the component parts without disrupting the underlying assembly pattern. It was, in fact, the ability of the pattern to withstand these distortions that led to the current body of work. The orthographic illustration in

Figure **8** shows how the component of a mirrored counterchange structure can be stretched without disrupting the underlying pattern. The distortion of the part along the dados does little to alter the part's profile. The resulting lattice has an interesting undulating quality.

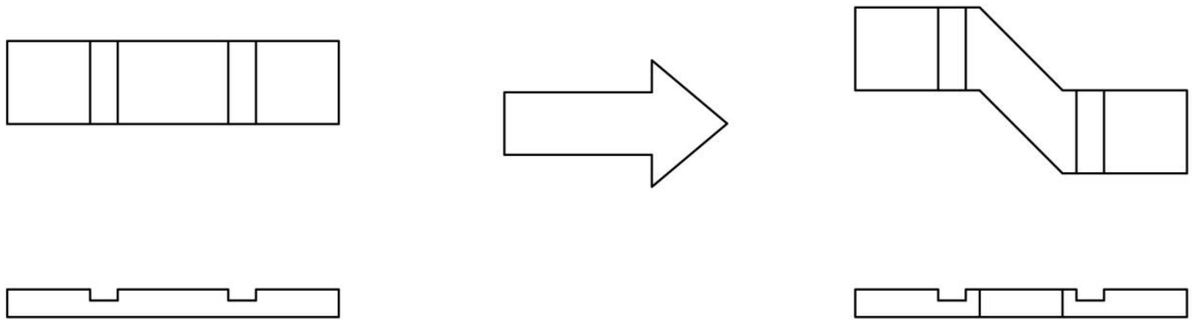

Figure 8: Mirrored counterchange lattice component stretched upward parallel to the dados.

Essential to creating cylindrical as well as closed counterchange structures is the need to bend the component parts. The diagram in
Figure **9** shows the manner in which some parts have been bent, allowing the resulting lattice to fold into itself. Cylindrical forms made of counterchange lattice require two different parts, one of which must be bent. To create a closed form, a component that has at least one angled dado and a bend must be used. Unless the proper combination of bend and dado angle is determined, the resulting lattice will not align. Some instances, most notably that of the unit part which is bent ninety degrees, will result in a lattice that devolves into a fully repeating three dimensional structure. The exhibition includes an example of this type of lattice.

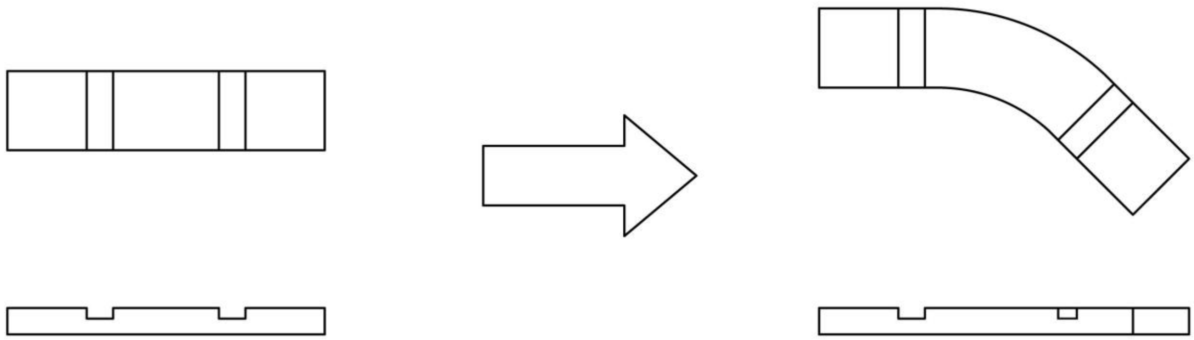

Figure 9: Counterchange lattice part bent to facilitate a lattice fold.

History

This body of work is a culmination of many years of education and choices. Were it not for decisions I made long before considering graduate study, this work could not have been created. Although the work is presented in a conceptual context, its development came entirely from a desire to design and build furniture in a way that makes employment as a designer-craftsman (also known as a studio furniture maker) a viable means of self employment.

In addition, I hold the belief that all art is a kind of self-portrait of its maker. Even an artist who is working hard to draw or paint with meticulous realism cannot escape some personal quality from creeping into the work. That some element of an individual's personality is manifest in his/her work is also observed in the built objects of a culture. Whether a can opener or a city, something about a culture is infused in the objects it makes. All things built by people carry this quality of expression. It is therefore impossible for me to view my own work outside the narrative of my own experience which is also a narrative of my time and culture. My history has shaped me, and those same forces also shape my work. It is for this reason that I will present in this section, not simply the history of my participation at VCU, but also some relevant life experiences outside VCU.

I have always been interested in making things. As the oldest son of a "do-it-yourselfer," I have benefited from an ample supply of tools and know-how. In high-school I took shop class for many years. I also took chemistry, physics, calculus, and computer programming, and believed that I was headed into a science-related future. After building a kit oscilloscope in my senior year, I was hired by the University of Maryland's Charged Particle Beam Lab as a research technician. While there I was exposed to many of the various disciplines that make physics research happen. I learned about high-voltage systems, plumbing microwave wave guides, designing and building diagnostic probes, and a variety of data collection techniques. In addition, I was trained as a machinist and was charged with designing, building, or modifying parts of experimental apparatus. This involved machining to close tolerance a range of materials including copper, lead, iron, steel, stainless steel, brass, aluminum, graphite, acrylic, delrin, polyethylene, phenolic, and others. Techniques like soldering, welding, riveting and bolting were also used. The experience was invaluable and gave me an expanded understanding of how things are made.

It is with some irony that I realized in college that science was not right for me. Gradually my interests changed and I became attracted to art, design, and poetry. After several changes of major I graduated with a degree in General Studies. The required two majors and one minor were art, creative writing, and German respectively. Unsure of what to do next, I began looking at graduate programs, and discovered furniture-making in a graduate catalog. Although I lacked the prerequisite skills to be accepted to graduate school, I applied to and was accepted at Genoa, a private two year program of furniture study in upstate New York. Although my time at Genoa was cut short by its bankruptcy in my final semester, the education was excellent. After Genoa I was accepted as the Artist in Residence for woodworking at the Appalachian Center for Crafts. Afterwards I opened my own studio in Frederick, Maryland and was self-employed for ten years.

It was during this time of self-employment that my current opinions concerning studio furniture were formed. While working for myself I made furniture for galleries, made studio furniture and marketed it, attended wholesale and retail crafts shows, promoted myself, and tried to establish a viable career as a studio furniture maker. In the end, however, making studio furniture never provided enough money to make a living. The expense of custom furniture, and the difficulty of finding buyers, made it necessary to seek other types of woodworking to help support my studio. While attending shows and conferences, I gradually learned that few people were able to make a living from their studio work. In fact, many became frustrated and left the field.

Eventually, I decided to close my business. This coincided with getting married and moving to Massachusetts. While there, I began working on a strategy to reenter the field in a more satisfying and profitable way. Because of previous experience with computers and programming, I decided that new technology might provide an answer to the problem of making a living as a designer craftsman. Low cost CNC routers were appearing in the marketplace, and I wanted to know more about them. I enrolled at my local technical college and learned CNC programming and operation as well as AutoCAD drafting and 3D modeling. Afterward, I was hired by a large architectural millwork firm to create and test CNC programs. When my wife's career required us to move, attending graduate school seemed like a good choice. An MFA would allow me to further develop my work as well as enable me to teach if the right opportunity became available.

During one visit to VCU I was delighted to learn that the Sculpture department had recently bought a ShopBot CNC router. Using the router would dovetail neatly with my earlier plans to find a viable living as an artist. What I did not anticipate was how difficult it would be to gain the needed access to the machine.

In June of 2006 my wife and I moved to rural Goochland County, Virginia as an intermediate point between Charlottesville and Richmond. My wife had accepted a position as a Breast Imaging Fellow at the University of Virginia hospital, and I was to begin classes at VCU in August. On July 30th my wife gave birth to our son 5 weeks prematurely. Helping to care for a premature child, commuting long distances to campus, attending graduate classes that were held at night, and a challenging academic load conspired together to leave me continuously sleep deprived. This impacted my production of work, especially during the first semester of graduate school when I managed only to complete two plant stands. I also attempted to gain access to the CNC router through independent study, but was told that I needed to take the CNC router class in order to use it. I signed up for the course in the spring semester with an agreement from the instructor to rout my projects by appointment. However, it proved difficult to schedule supervised router appointments and I continued to have insufficient access to the machine to produce a viable body of work for candidacy.

Uncertain if sufficient CNC access would ever be granted, I produced an unrelated body of work for candidacy. This work involved my political opinions and a disgust with consumer culture. Pieces for candidacy included a series of iconoclastic fishing lures made from candy, cigarettes, and other sources of addiction; a Molotov cocktail with an attached handcuff; a series of carved spoons that explored the emotional content that can be present in a simple object; and a set of handcuffs with a credit card connecting them instead of a chain.

The main portion of my candidacy exhibit, however, was an installation of a water-boarding device as a protest of our country's use of torture against suspected terrorists. The work included an inclined surface with a stockade for the victim's legs, and a "water tower" to supply the requisite liquid. An oil barrel was used to prop the end of the stockade and another was used atop the tower. A gasoline nozzle dispensed the water, and everything was painted black. The space was lit with a single lamp located above the spot for the victim's face.

Although the work was timely and well received, I quickly lost interested in it. I have never envisioned myself as a sculptor, and a future making purely sculptural works seemed unappealing. At the end of the second semester, I purchased a spot in ShopBot's monthly CNC training seminar held in Durham, North Carolina. Thereafter, I was granted permission to use the router by the sculpture department, and I am indebted to Amy Hauft, the Sculpture Department Chair, for changing their policy and allowing me to use the machine.

During the summer following my first year at VCU I used the CNC to build and decorate a jeweler's bench for my classmate Gabriel Craig. The bench design was created in AutoCAD then converted into files for routing. The design used plywood as the main material and was supplemented with a top of MDF. Incised patterns inspired by historical models were routed into the surfaces of the bench. Because drafting decorative elements is exceedingly time consuming, the bench took longer to build than was anticipated. However, once the design was complete, I realized that it could be reproduced multiple times at a substantial savings. Making the bench proved that CNC routing could provide a feasible way to make money as a studio furniture maker.

During the summer of 2007 I also had an opportunity to reexamine my educational priorities. At this time I decided to discontinue my participation in the Preparing Future Faculty program as well as to stop teaching. Although the decision was difficult and disappointing, it was an essential one which allowed me to establish a realistic balance between my roles as long-range commuter, graduate student, husband, and father.

Although I began my second year with full access to the CNC machine, I used it little due to other academic demands. The fall semester was both rewarding and extraordinarily difficult, as this was the semester where I satisfied my art history requirement. Rather than take a regular art history course, I chose to do a directed research project under the supervision of Dr. Charles Brownell. My topic was aesthetic movement furniture made in Richmond. Ultimately, the project focused on the furniture manufacturing business of the Belvin family, which was begun by John Allan Belvin in 1833 and was continued by his son Preston Belvin until the mid 1890's. The project required long hours in various libraries including the Library of Virginia, the Virginia Historical Society, and the archives of the Valentine Richmond History Center. By tracing obituaries, newspaper articles, advertisements, census data and other historical documentation, a history of the family and their business was unearthed. In addition, extensive time was spent attempting to locate surviving family descendants. Eventually, some members of the family were located and they have assisted me in learning more. After sharing my research findings with Dr. Brownell, I was invited to present the results at the upcoming VCU symposium on architecture and the decorative arts which will be held at the Virginia Historical Society in November. Consequently, research into the Belvin family will continue until that time and perhaps thereafter.

Although the historical research was both time consuming and rewarding, I also found time to further my work on CNC techniques in the studio setting. Because of the difficulty I experienced creating decorative motifs using AutoCAD drafting, I decided to focus my attention on the software side of the design process. During this time I investigated the nature of certain interlocking patterns created with AutoCAD, which I then modified in Adobe Illustrator. Although I felt then, and still feel now, that this investigation yielded important results, the work was not well received by my committee. After some additional experiments designing pattern for plywood furniture forms, I abandoned the idea of applying surface decoration to furniture. Thereafter I returned to making three dimensional studies routed from MDF, and grappled with bridging the gap between a virtually designed piece and one that is conceived by freehand drawing at full scale.

In early February I got the idea to take particular patterns that I developed in the fall and to treat them as structural elements instead of surface decoration. This has lead to a whole variety of experiments and resulted in the body of work which is presented here. By using software to design my work, I have been able to create forms which would otherwise have been difficult to conceive. In addition, I have used the CNC router in one of its most effective capacities – tireless repetition.

The new work, although presented in a conceptual context, also has the possibility to be developed into furniture and products. These, as far as I know, would be unique in the marketplace. The work, then, also satisfies my own desire to make useful things.

As I conclude this narrative I realize that the current work came into being in a short period of time. However, were it not for the fluency that I gained with software design, the experience using of planar materials to create three dimensional forms, as well as additional experience routing with the CNC, the rapid development of the work would not have been possible. Although the final expression of the work is new, the skills needed to create it have been building for a long time.

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VITA

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